

Formation of In-Situ Composite during Reactive Wetting and Imbibition Ta by Cu(B) Melt

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Abstract : Continuous layer of tantalum boride is formed on the surface as a result of reactive wetting of oxidized tantalum by copper melt with boron at a temperatures above 1150 °C. An increase in the wetting temperature above 1400 °C leads to a change in the formation mechanism of tantalum borides, they are formed in the nanosized flakes. In the presented work, we studied the process of copper-based in-situ composite formation, strengthened by the particles of tantalum borides. We investigated the structure of the formed particles, the conditions, and the kinetics of their formation. Dissolving boride particles do not have time to mix uniformly in the melt upon sufficiently rapid cooling and form a macrostructure, partly repeating the shape of the metallic tantalum. This allows to set different gradient structures in the copper alloy. Such macrostructures have been obtained. Boride particles and microstructures were studied by scanning and transmission electron microscopy, and regions with particles were investigated by nanoindentation. In this work, we also measured the kinetics of impregnation of porous tantalum with copper-boron melt and studied the structures of the composite, in which the melt filling the interpore space is saturated with boride particles.

Keywords : copper, tantalum borides, in-situ composites, wetting, imbibition

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